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Precipitation monitoring at Yucca Mountain

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Precipitation Monitoring at Yucca Mountain

Task ORD-FY04-007

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Introduction

- Objectives
- Status of the Task to Date
- Network Overview/ Equipment
- Data Trends
- Uses and Collaborative Projects
 - Spatial Interpolation of YM Rainfall
 - Storm Event Analysis
 - Shallow Groundwater Response to Rainfall
 - UE29a1 Water Level Response to Barometric Pressure Fluctuation

Status of Task 7

OBJECTIVE

- To obtain a continuous, accurate record of precipitation in the vicinity of Yucca Mountain

CURRENT STATUS OF TASK 7

- Continuous record from 1/1/2001 – 12/31/2005 & all supporting documentation submitted to TDA in compliance with QA requirements
- 1/1/2006 – 12/31/2006 currently being compiled and reviewed
- All milestones to date met on or before schedule

Precipitation Monitoring Equipment

- 17 original sites:
 - Qualimetrics rain gauge
 - Datalogger, backup storage module & power supply
- Heated gauge sites:
 - Hydrologic Services LP TB-3 rain gauge
 - Temperature sensor
 - Pressure Transmitter
 - Datalogger, backup storage module & power supply
- Quality Assurance
 - Resolution: 0.01 in (0.254 mm)
 - Accuracy: +/- 10%
 - Range: 0 – 28 in (0-700mm)/hr
 - Heater : 14 °F to 40 °F



Yucca Mountain Preliminary Precipitation Data

■ Winter frontal storms:

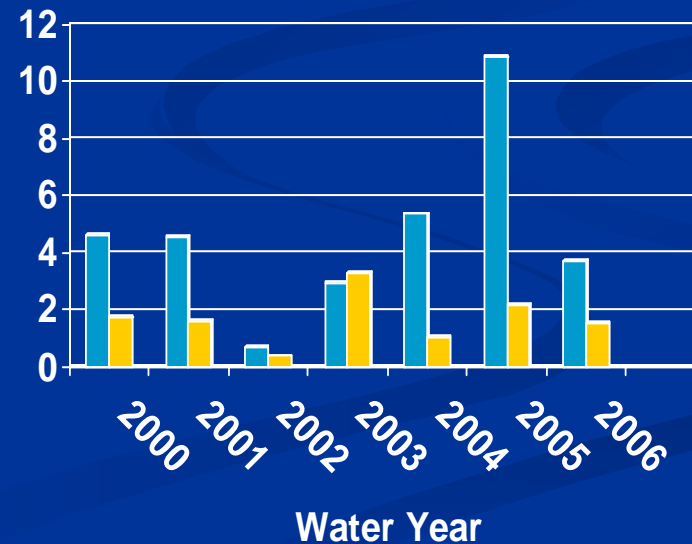
- Regional in scale
- Measurable at multiple locations
- Longer duration

■ Summer (monsoon) events:

- Localized
- High intensity, shorter duration

■ Winter Precip (10/1 - 03/31)
■ Summer Precip (04/01 - 09/31)

Seasonal Precipitation

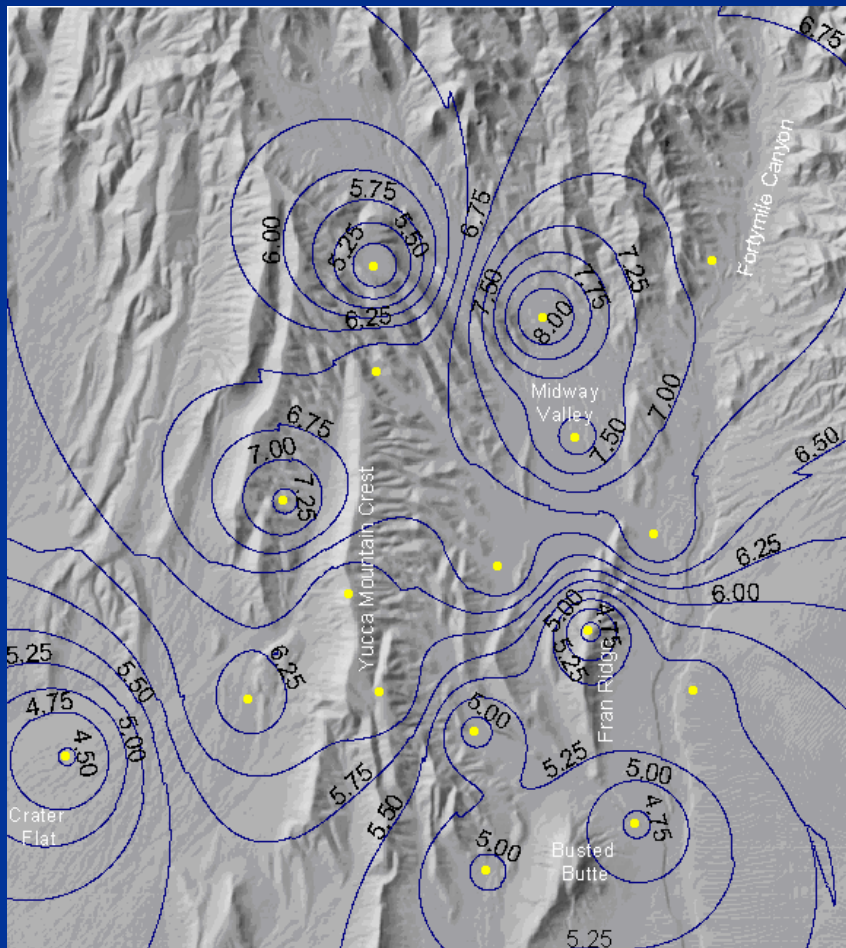


Yucca Mountain Preliminary Precipitation Data

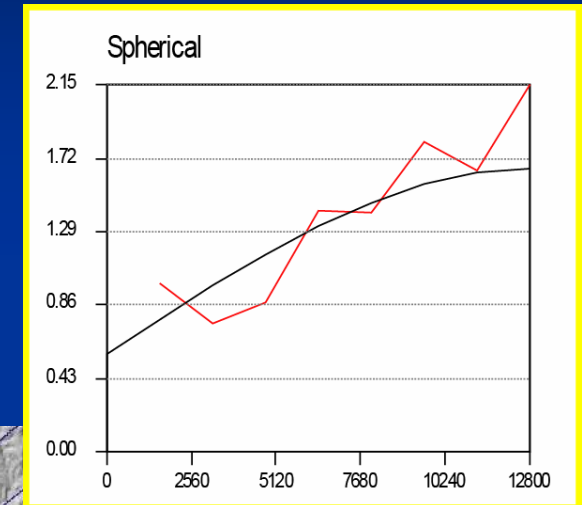
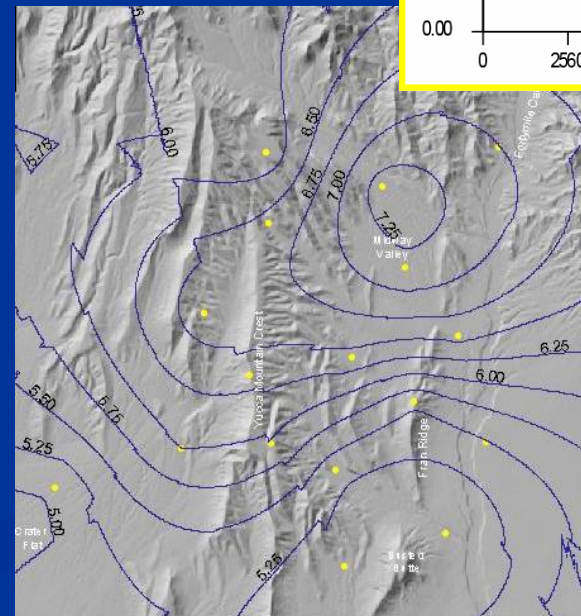
	1999/ 2000	2000/ 2001	2001/ 2002	2002/ 2003	2003/ 2004	2004/ 2005	2005/ 2006
Average Annual Rainfall by Water Year (in)	6.38	6.16	1.11	6.30	6.42	13.09	5.22
Median Annual Rainfall by Water Year (in)	6.31	6.07	1.06	6.26	6.57	12.79	5.47
Min	4.02	2.47	0.56	3.29	2.68	9.31	3.63
Max	8.08	9.28	1.84	7.95	9.25	18.30	6.75

Yucca Mountain Precipitation Data Spatial Interpolation

Inverse Distance



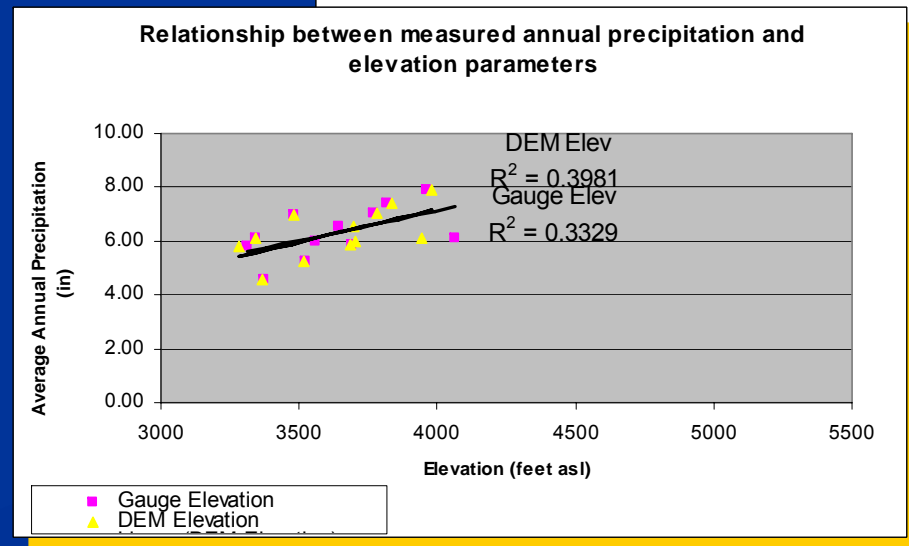
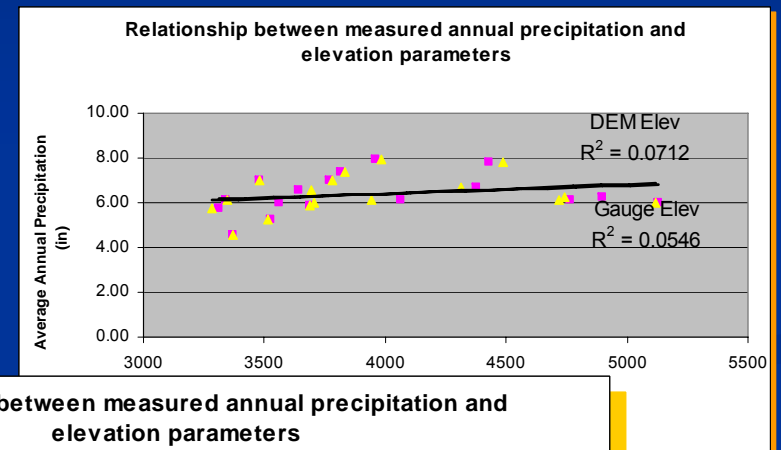
Ordinary Kriging



Model	Spherical
AIC	0.23
BIC	0.46
SSE	0
RSME	0.35

Yucca Mountain Precipitation Data Spatial Interpolation

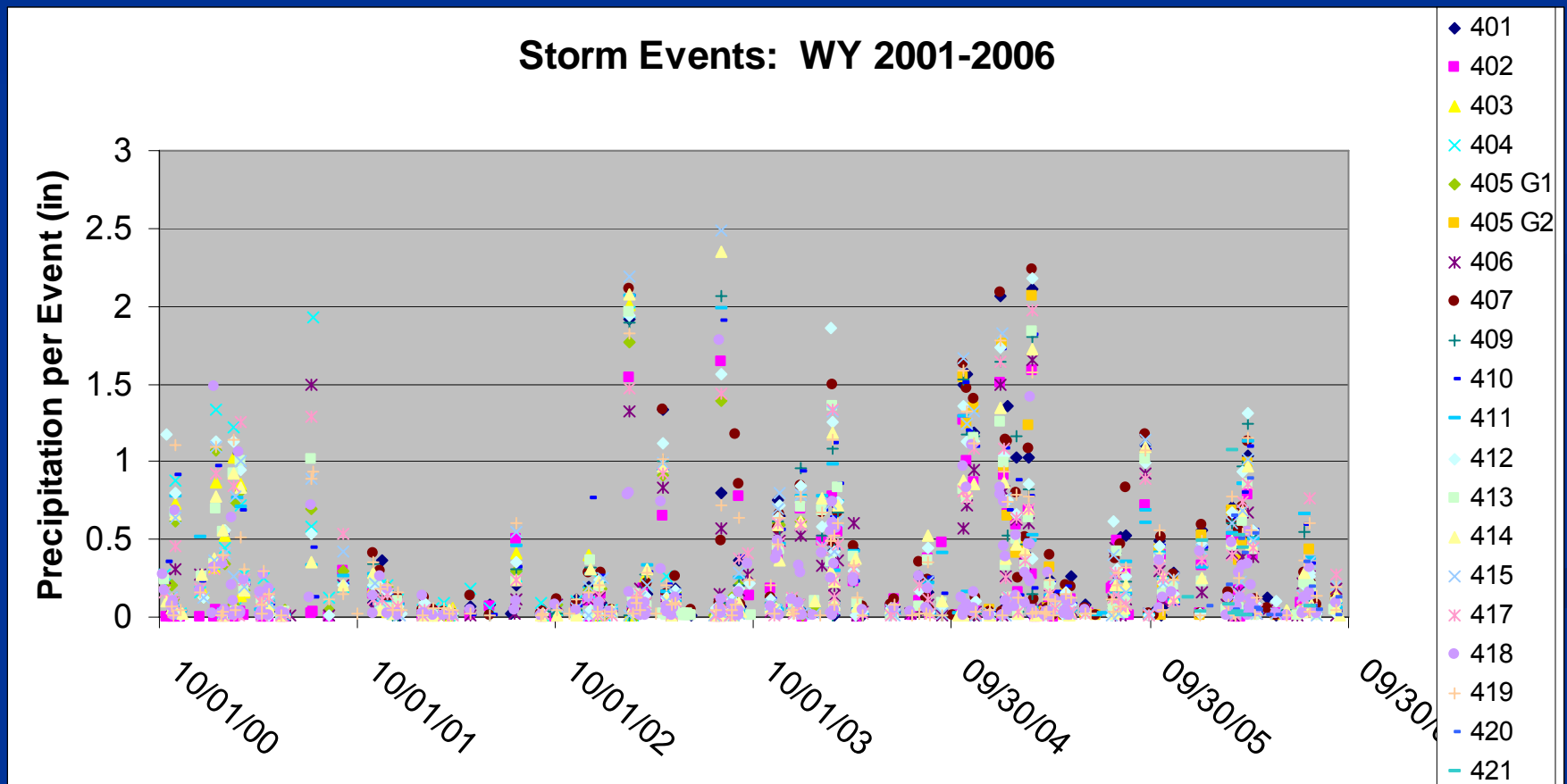
- Precipitation – elevation relationship: Weak correlation
 - Small coverage area
 - Localized nature of arid region rainfall
 - More complex topographic and seasonal effects



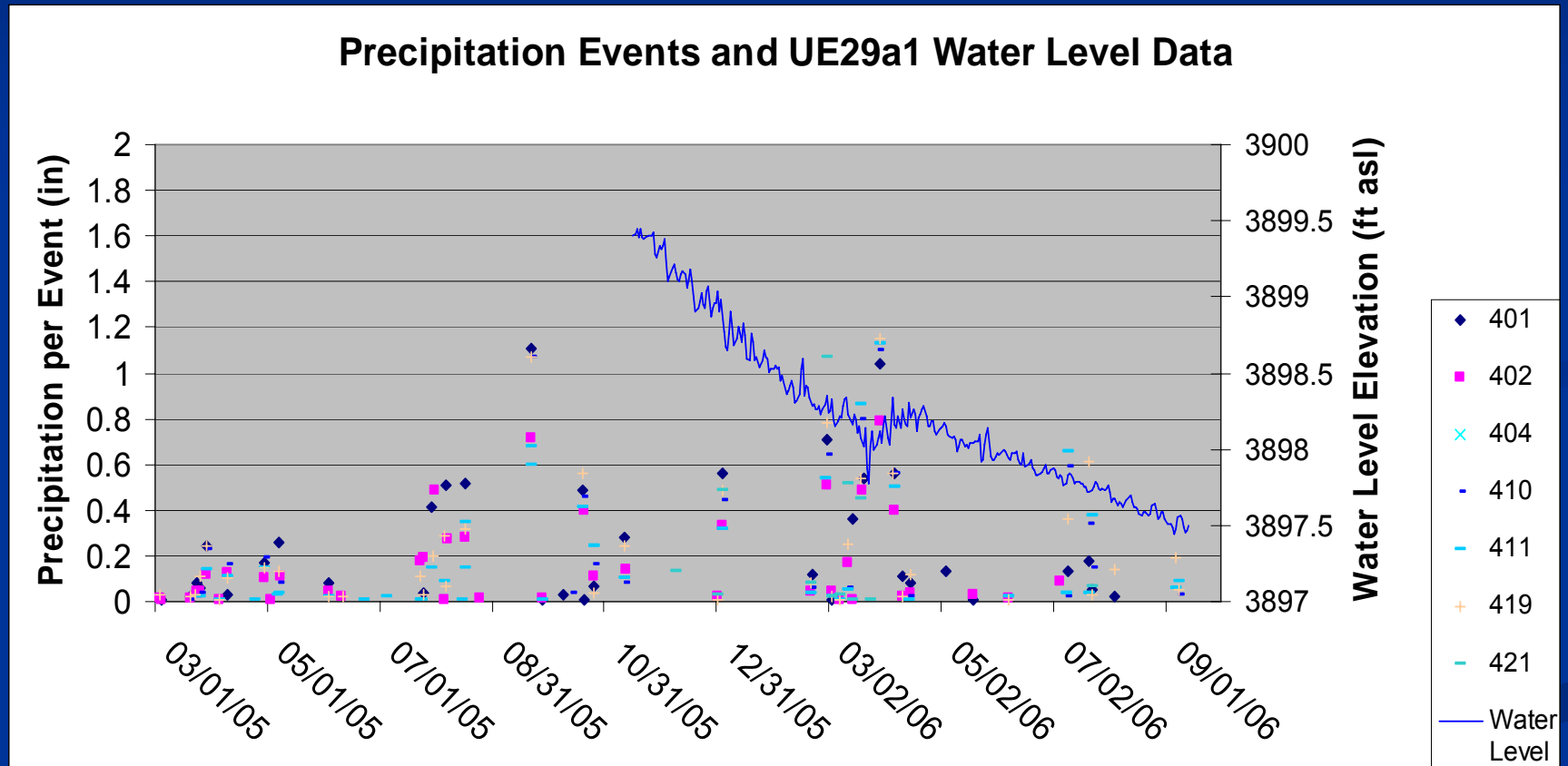
Storm Event Analysis

Preliminary Data

- Storm Event: ≥ 0.01 in/ 24-hour period
- Useful for understanding environmental responses to precipitation events



Storm Event/ Shallow Ground Water Response



Barometric Pressure Effects on Groundwater

UE29a1 Total and Corrected Heads using Barometric Efficiencies

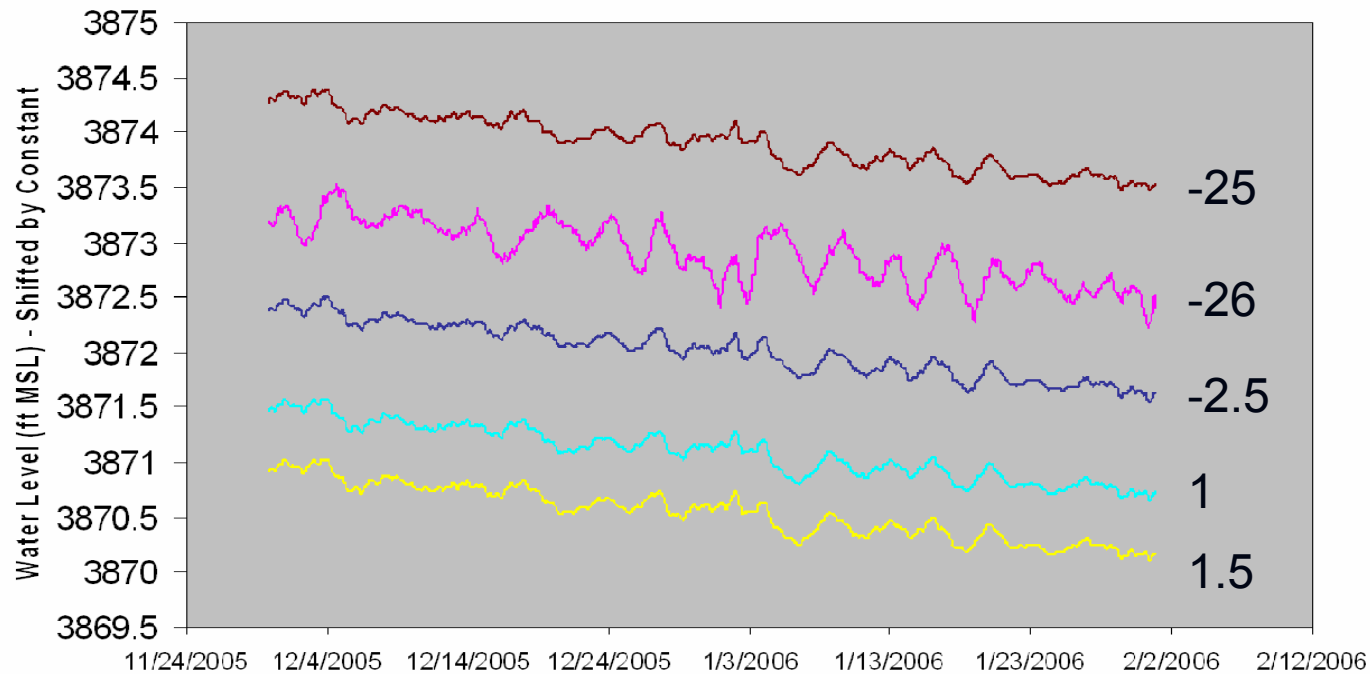


FIGURE 3. UE29a1 A.) Water levels; B.) Total Heads; and corrected heads using barometric efficiencies from C.) long-term, D.) Clark's method, and E.) short-term efficiencies. NOTE: Plots are shifted downwards by indicated constant for clarity.

— Alpha L
— Alpha S
— Alpha Clark
— Total Head
— Measured Water Level

Barometric Pressure Effects on Groundwater

Barometric Efficiencies for UE29a1 Data (Expected Value \pm One Standard Error)				
Linear Regression				Clark's Method
α_L	Standard Error	α_S	Standard Error	α_C
0.173614	± 0.010059	$\frac{0.00508}{2}$	± 0.008091	0.006812

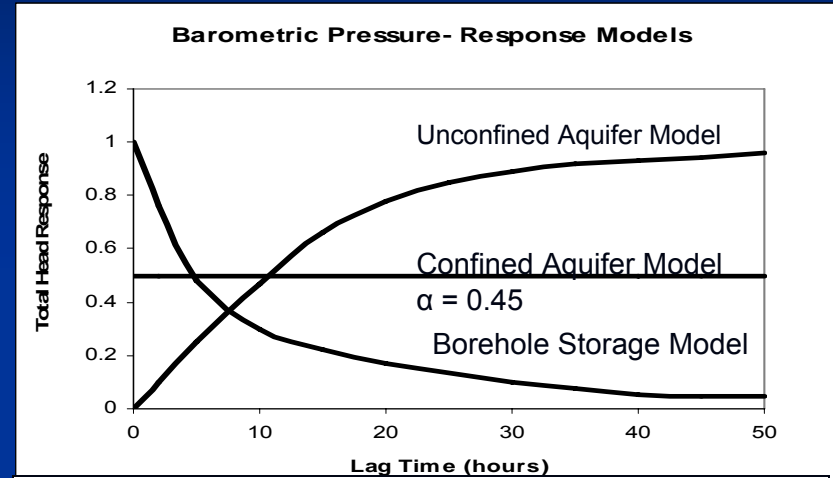


FIGURE 1: Summary of three types of barometric pressure response functions: Confined aquifer, Unconfined aquifer, and borehole storage/ skin effects.

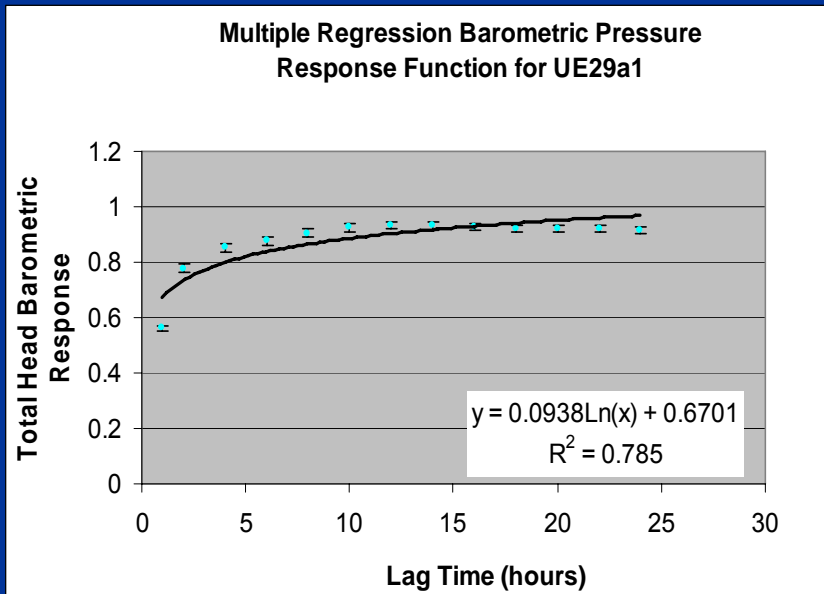


FIGURE 2: Regression coefficients for each lag time indicate UE29a1 displays response patterns associated with rapid response of an unconfined aquifer, trending toward a constant response after 10 hours.

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